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Omata et al.

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(54) **ELEMENT SUBSTRATE, PRINTHEAD, AND HEAD CARTRIDGE**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
B41J 2/05 (2006.01)

(52) **U.S. Cl.** **347/59**

(58) **Field of Classification Search** 347/59, 347/50, 54, 56, 57–58, 61–65, 44, 40, 20
See application file for complete search history.

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(74) *Attorney, Agent, or Firm*—Fitzpatrick, Cella, Harper & Scinto

(57) **ABSTRACT**

A small-size element substrate with high electrical efficiency can be achieved when a plurality of printing element arrays having the same discharge amount exist on a single element substrate, and transistors which form driver arrays corresponding to the respective printing element arrays are formed at different array densities including transistors which form a driver array corresponding to a printing element array having a different discharge amount. The area of each transistor of the first driver array corresponding to the first printing element array is set larger than that of each transistor of the second driver array corresponding to the second printing element array. The wiring width of the first power supply wiring pattern corresponding to the first printing element array in a direction perpendicular to the printing element array is set smaller than that of the second power supply wiring pattern corresponding to the second printing element array.

7 Claims, 15 Drawing Sheets

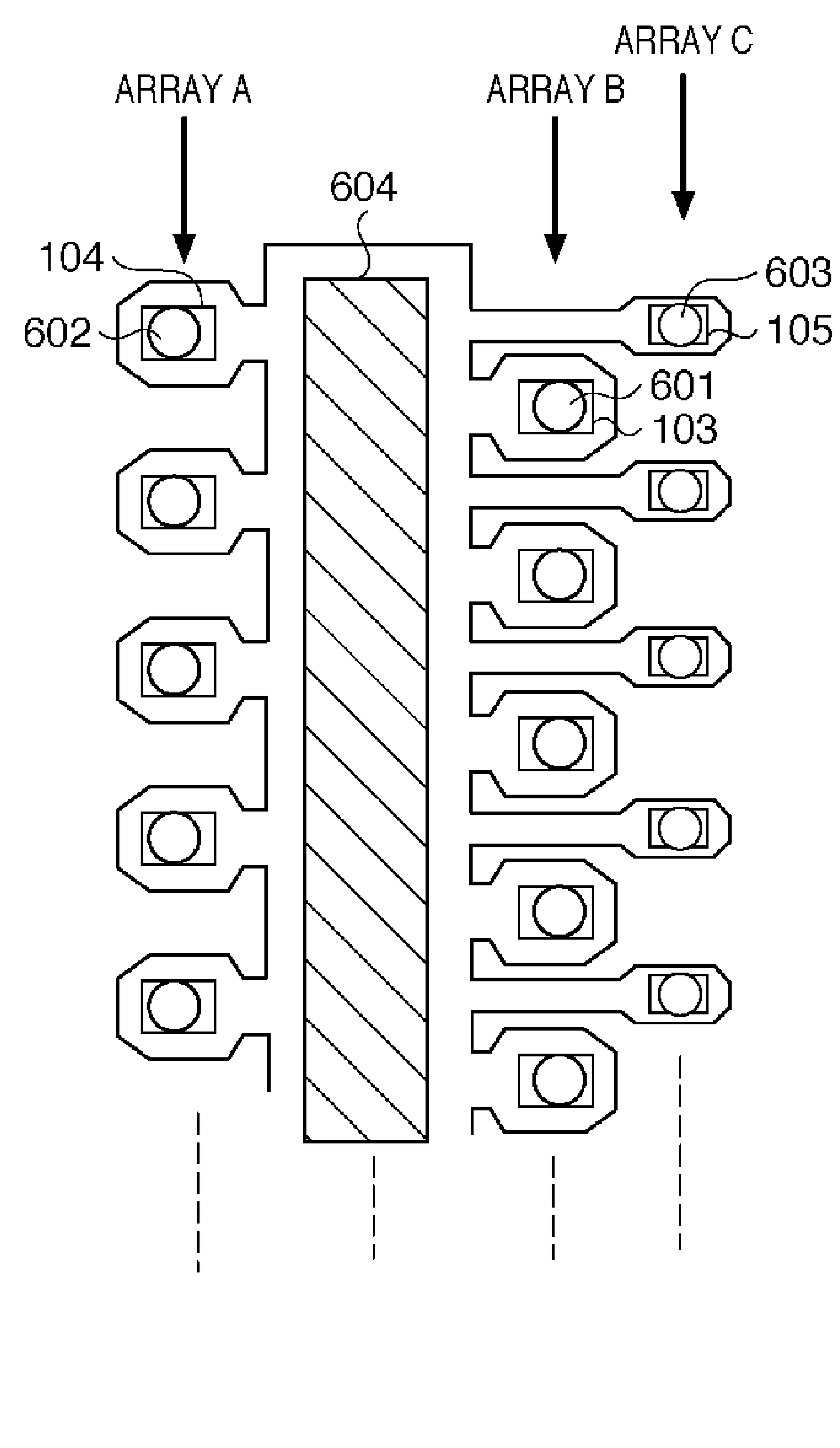


FIG. 1

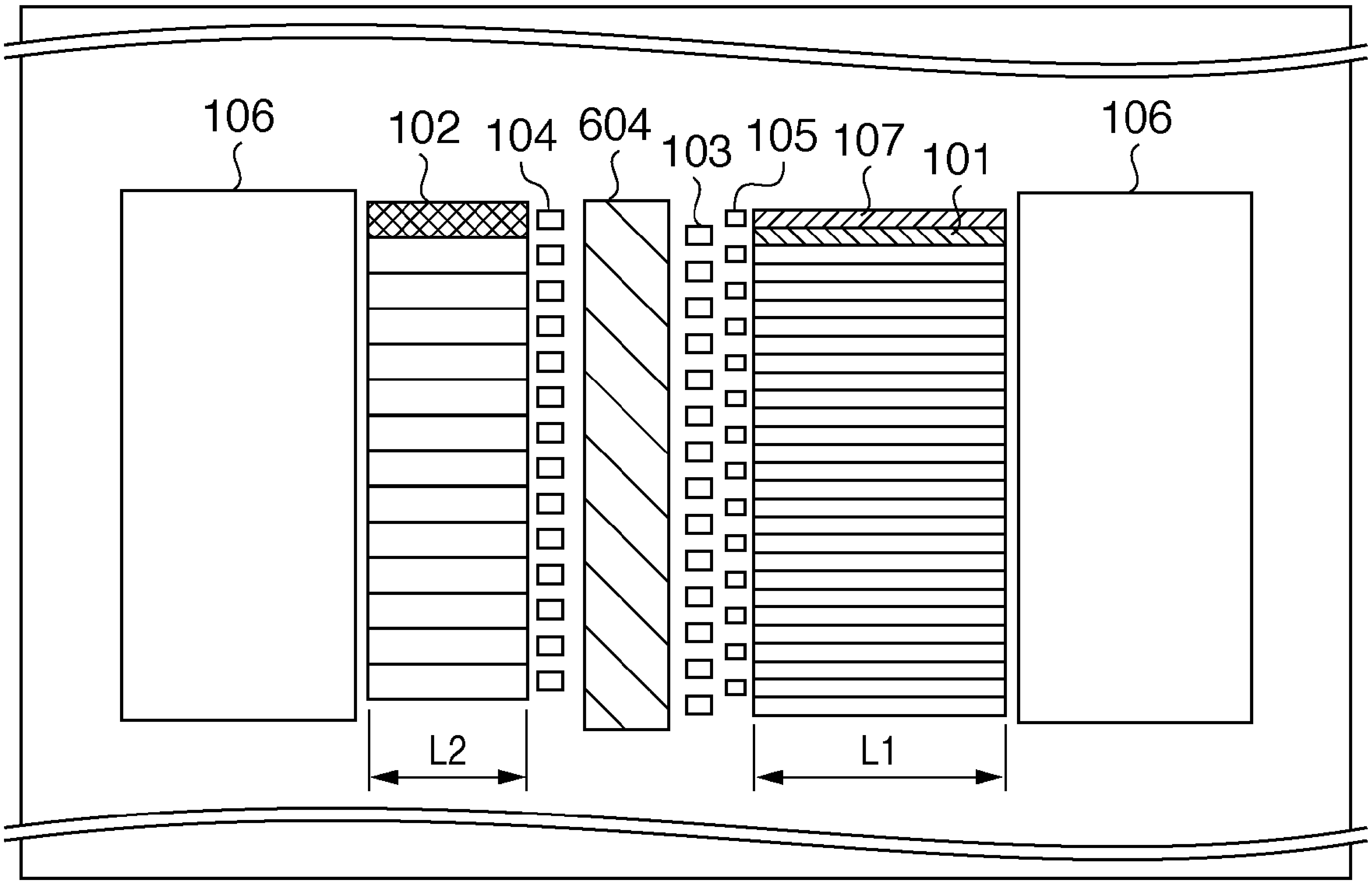
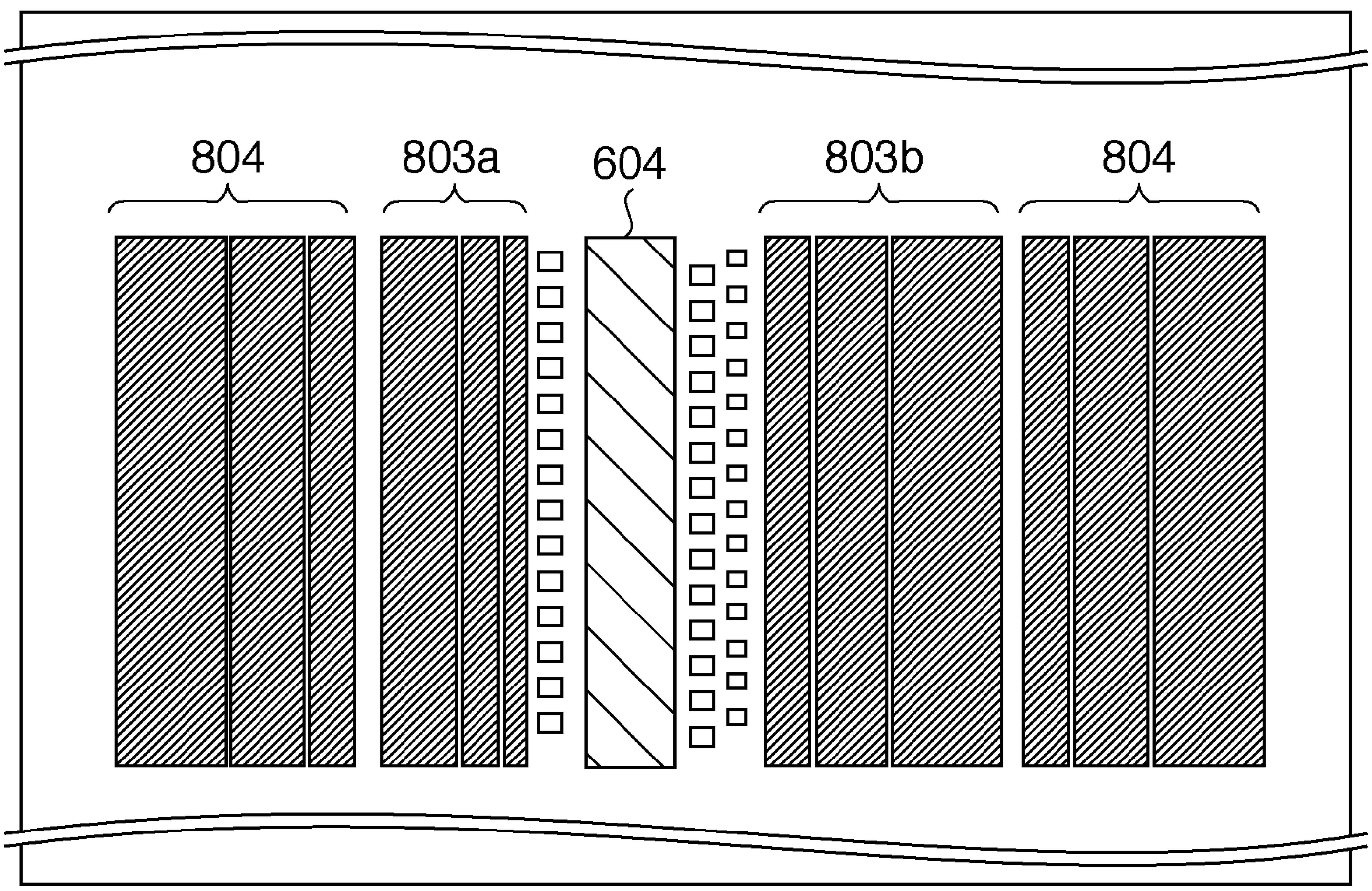


FIG. 2



F I G. 3

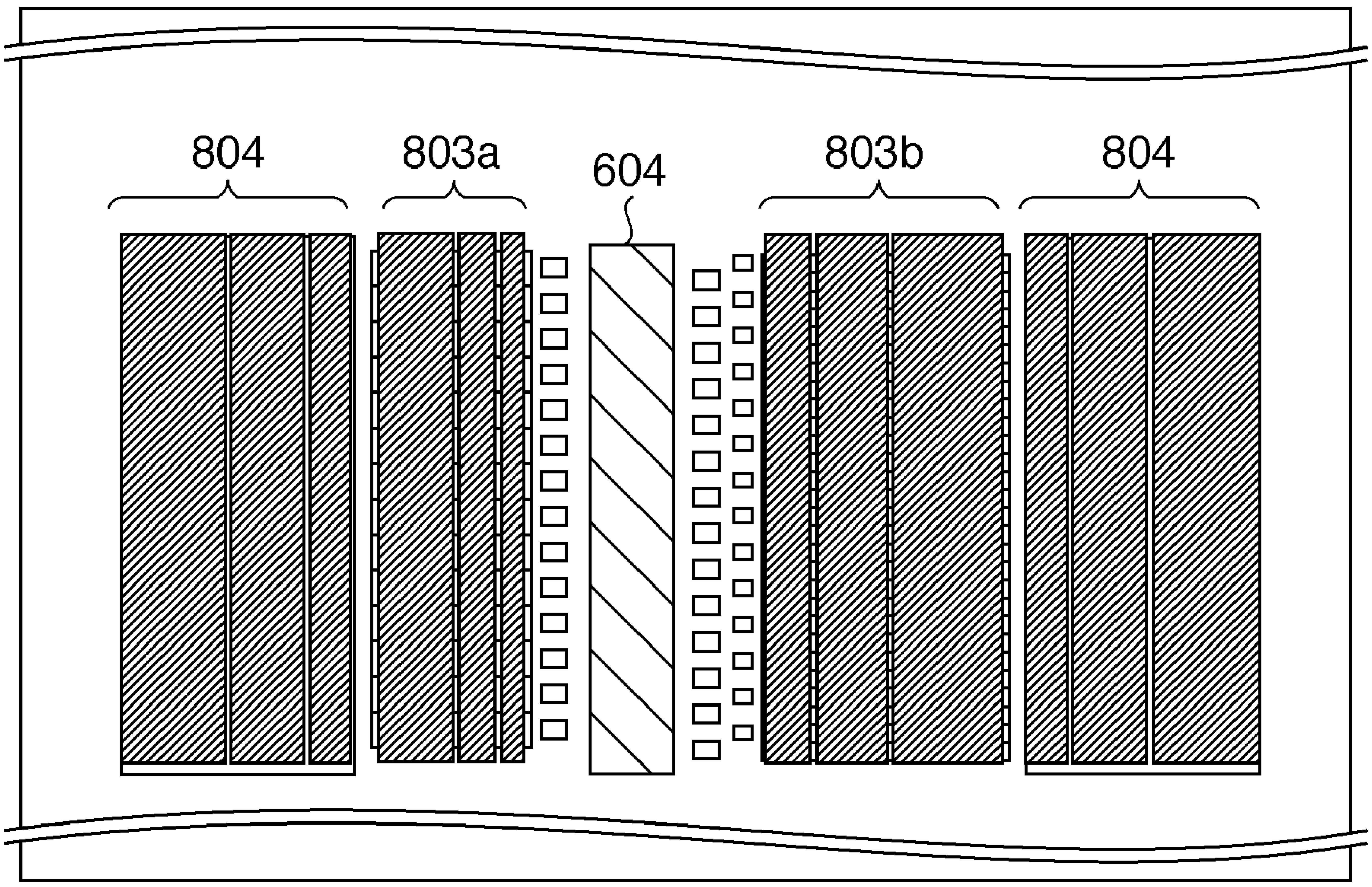


FIG. 4

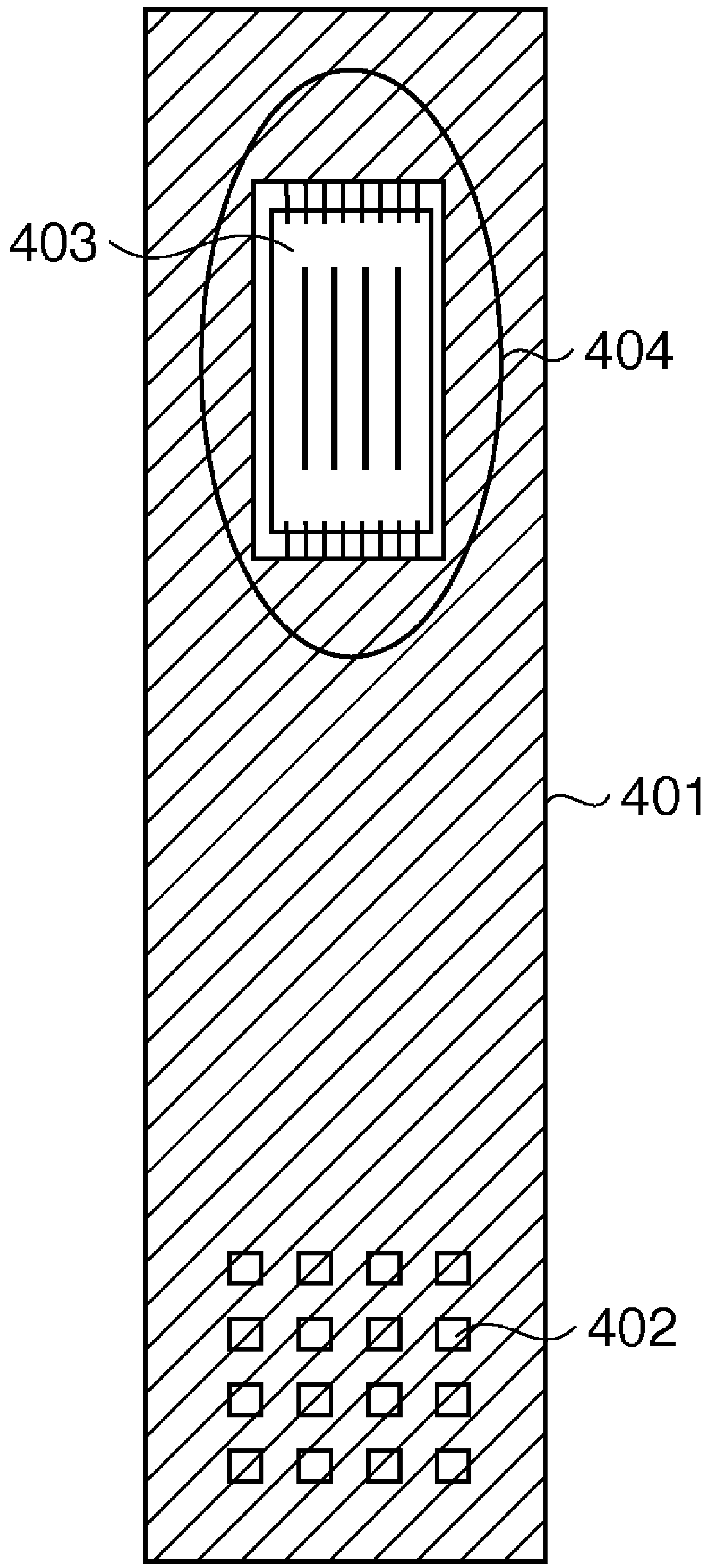


FIG. 5

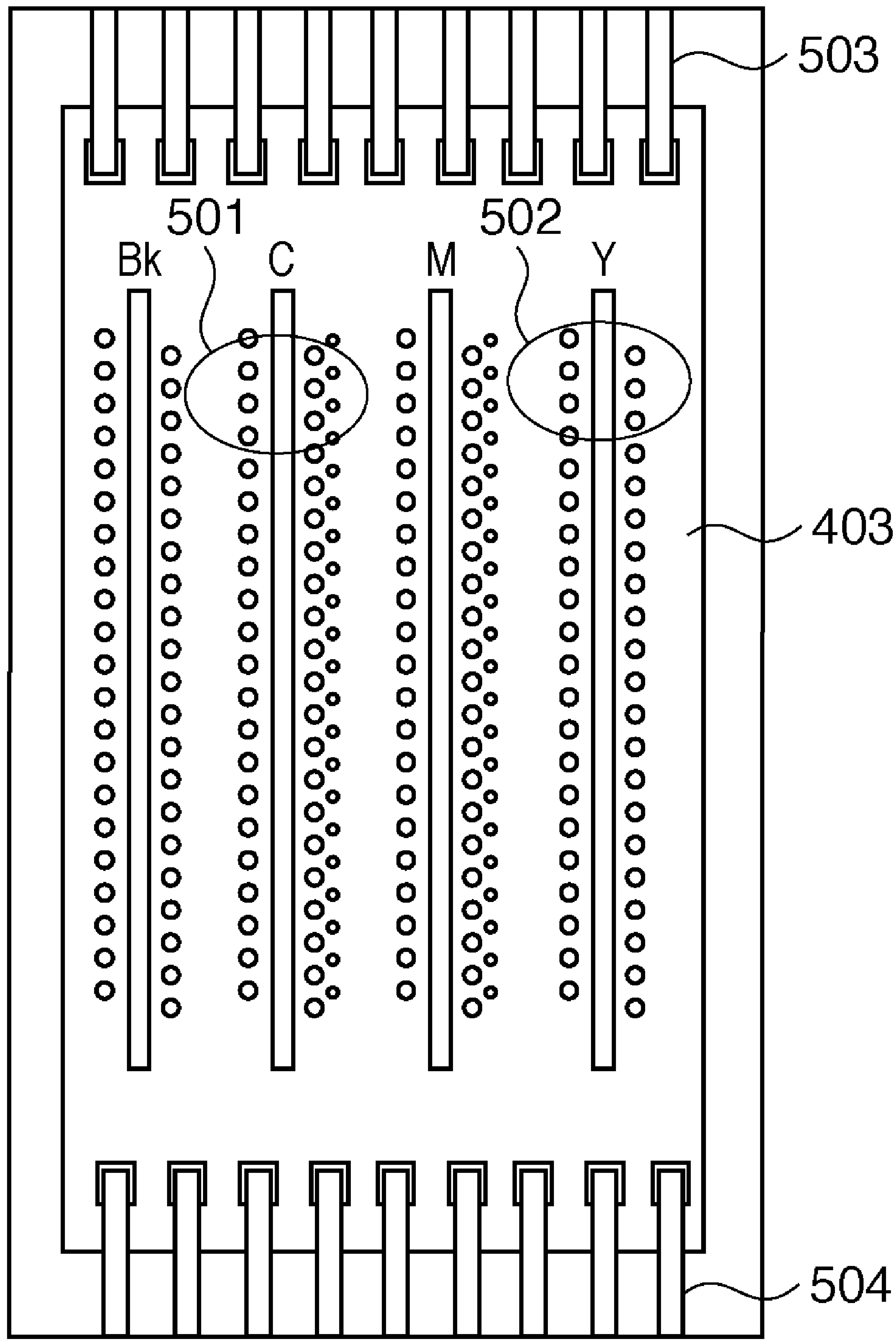


FIG. 6

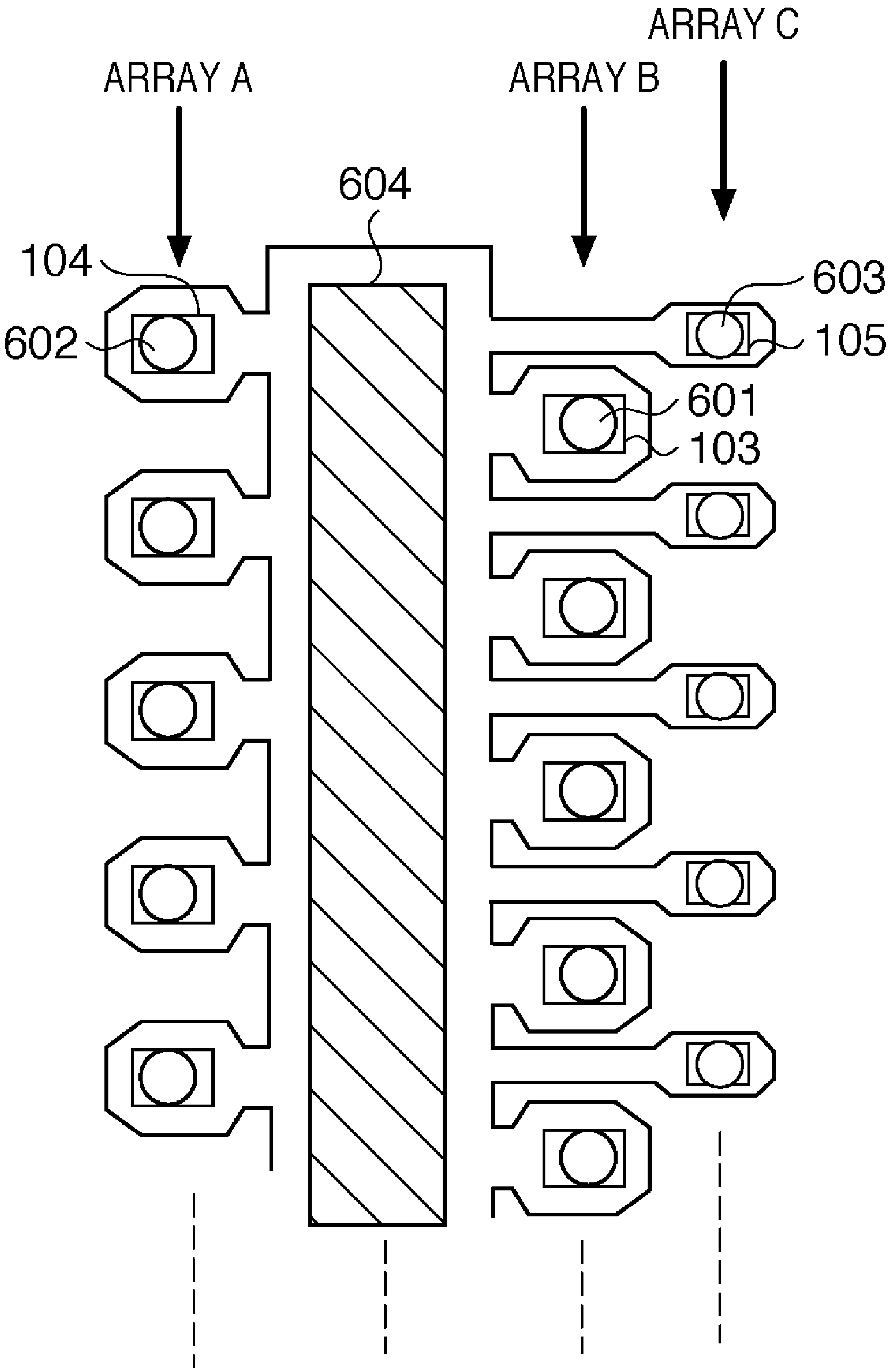
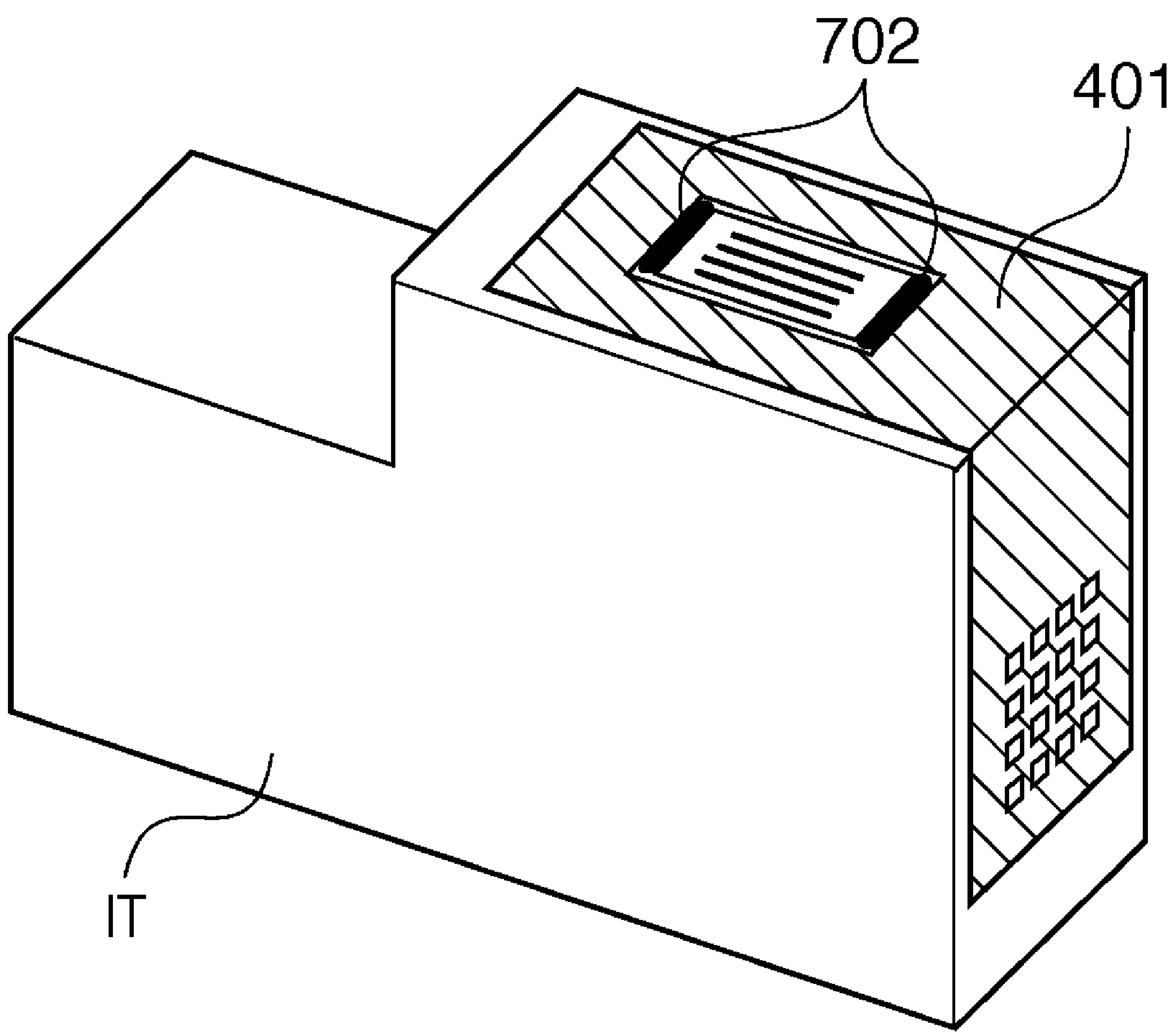


FIG. 7



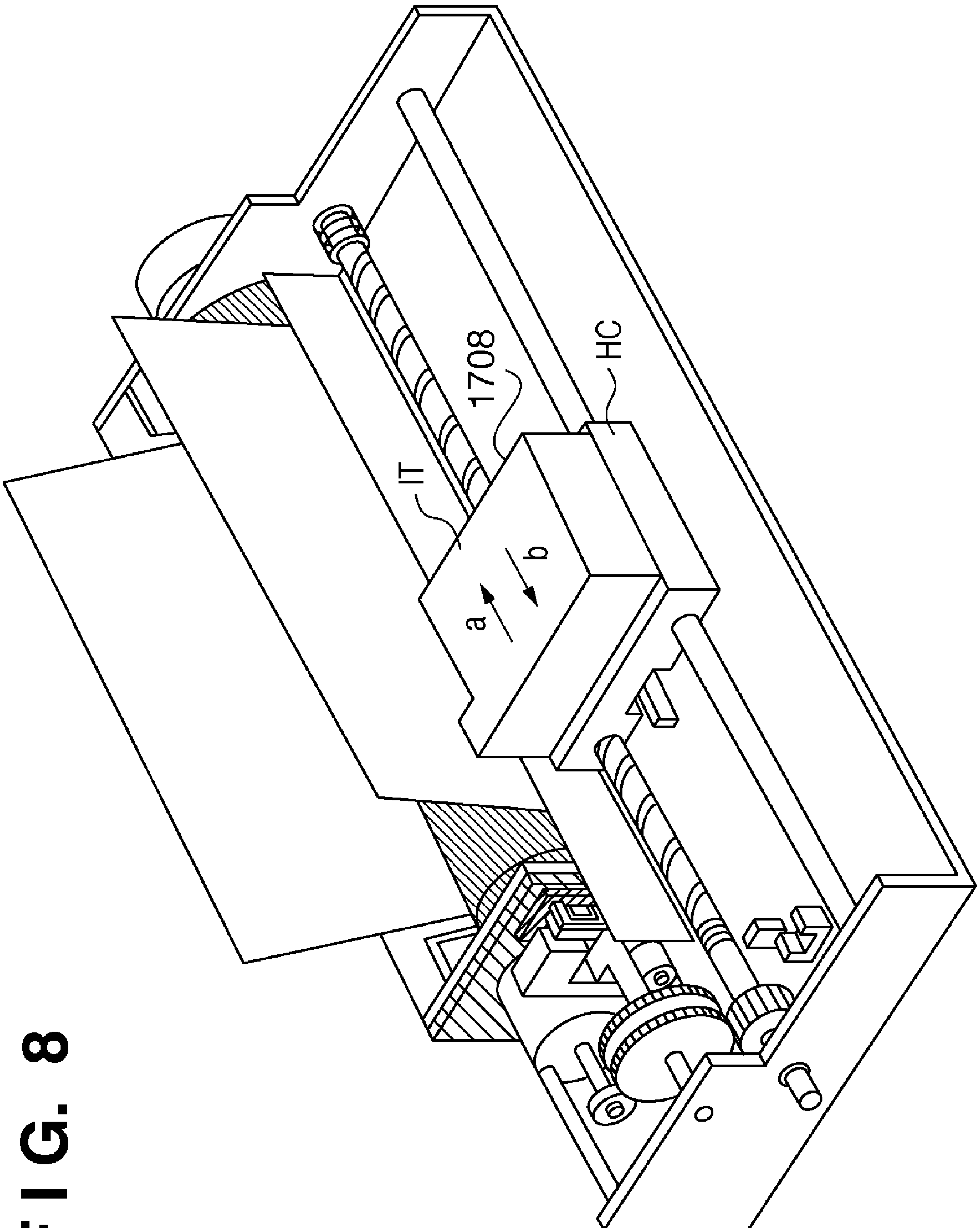


FIG. 8

FIG. 9

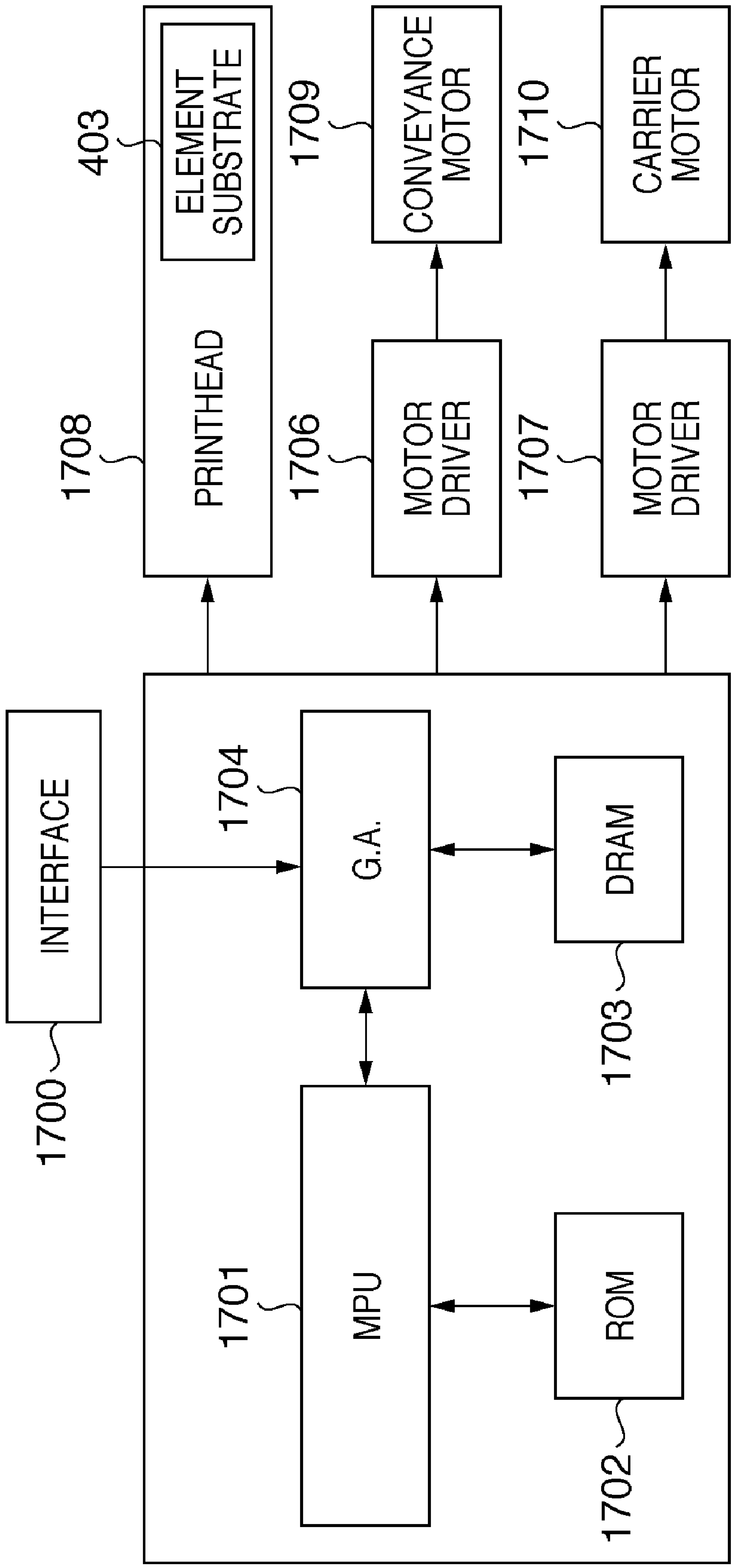

INTERFACE
1700
G.A.
1704
MPU
1701
DRAM
1703
ROM
1702
PRINTHEAD
1708
ELEMENT SUBSTRATE
403
MOTOR DRIVER
1706
MOTOR DRIVER
1707
CONVEYANCE MOTOR
1709
CARRIER MOTOR
1710

FIG. 10

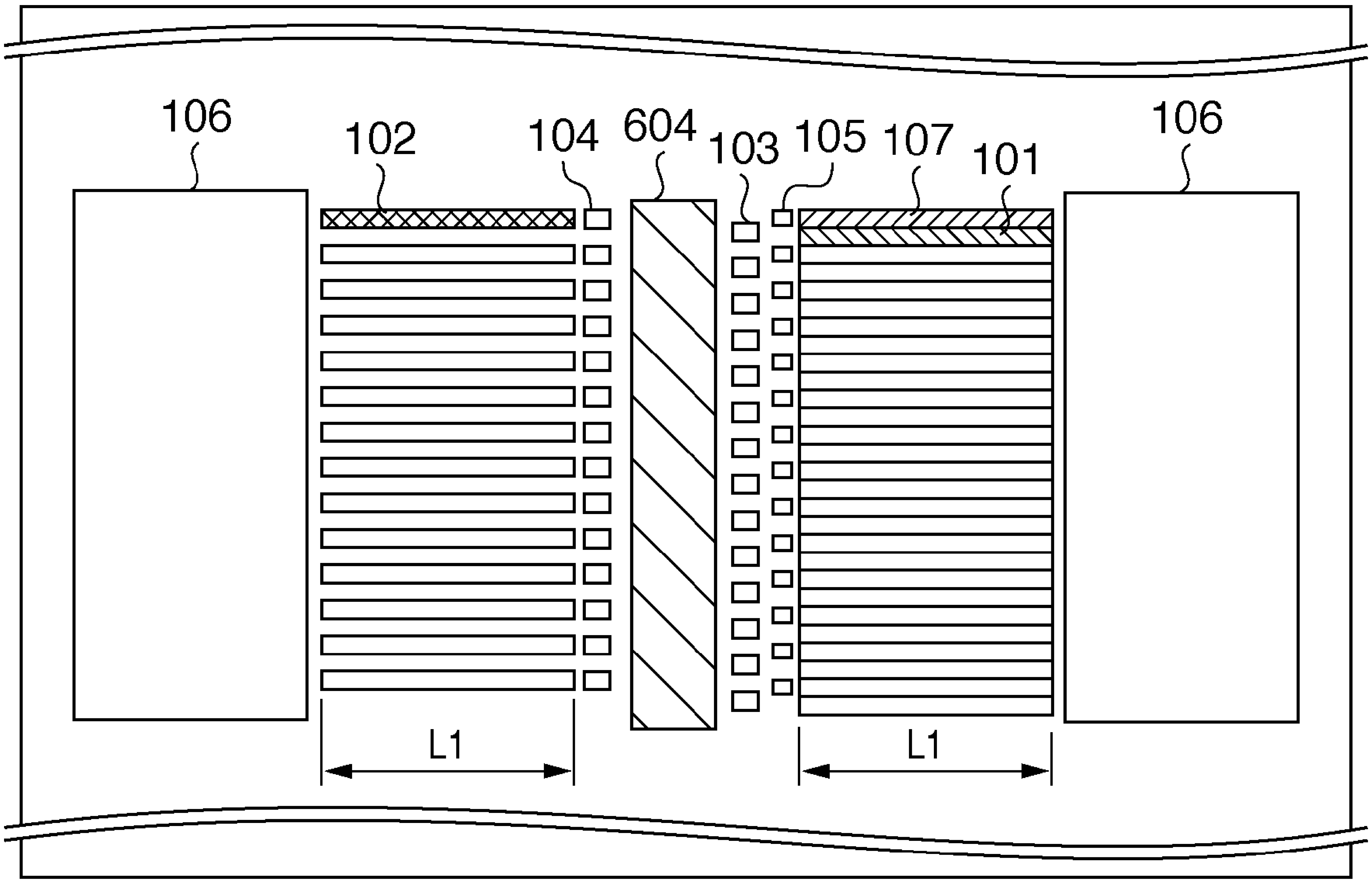


FIG. 11

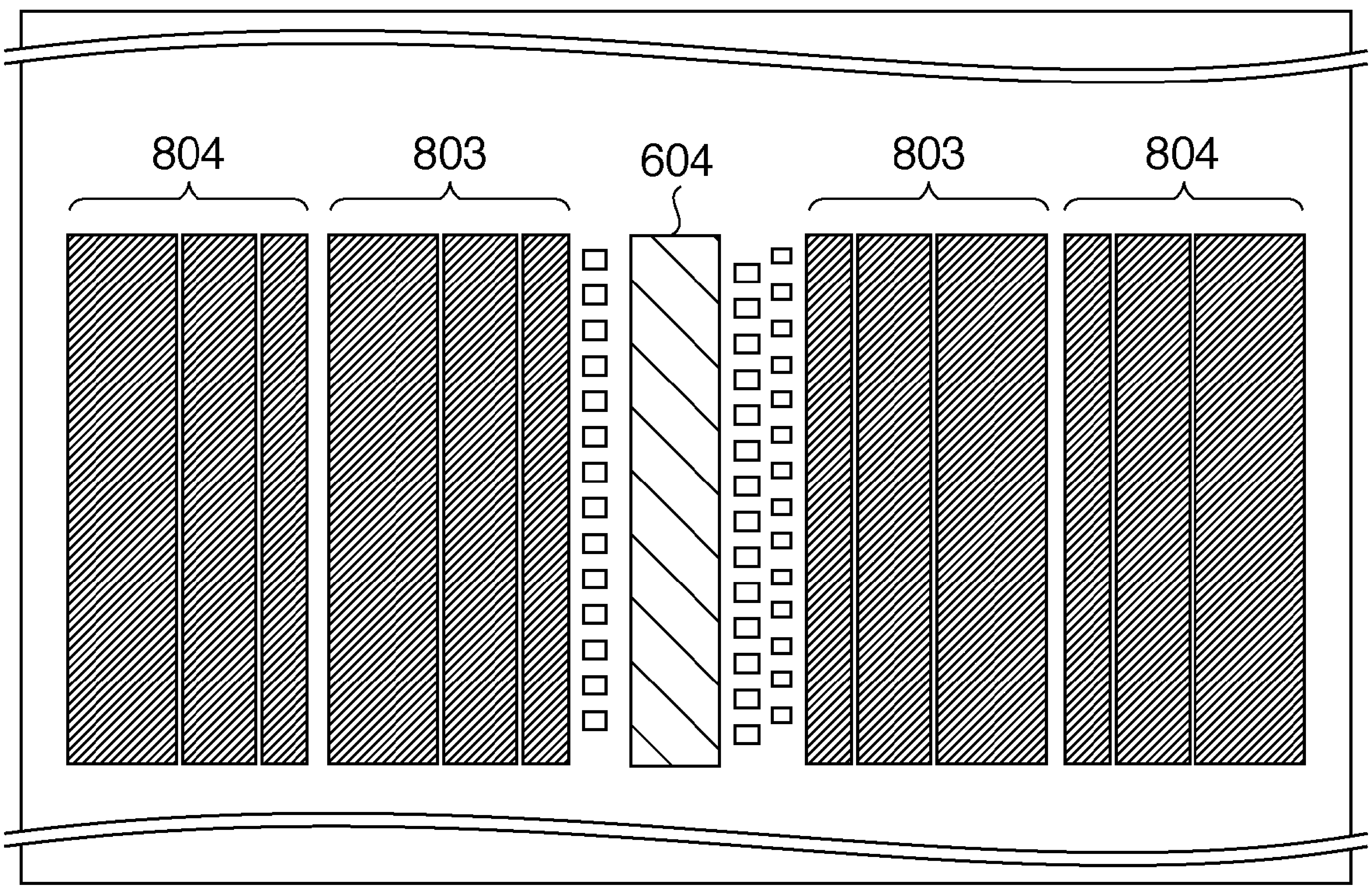


FIG. 12

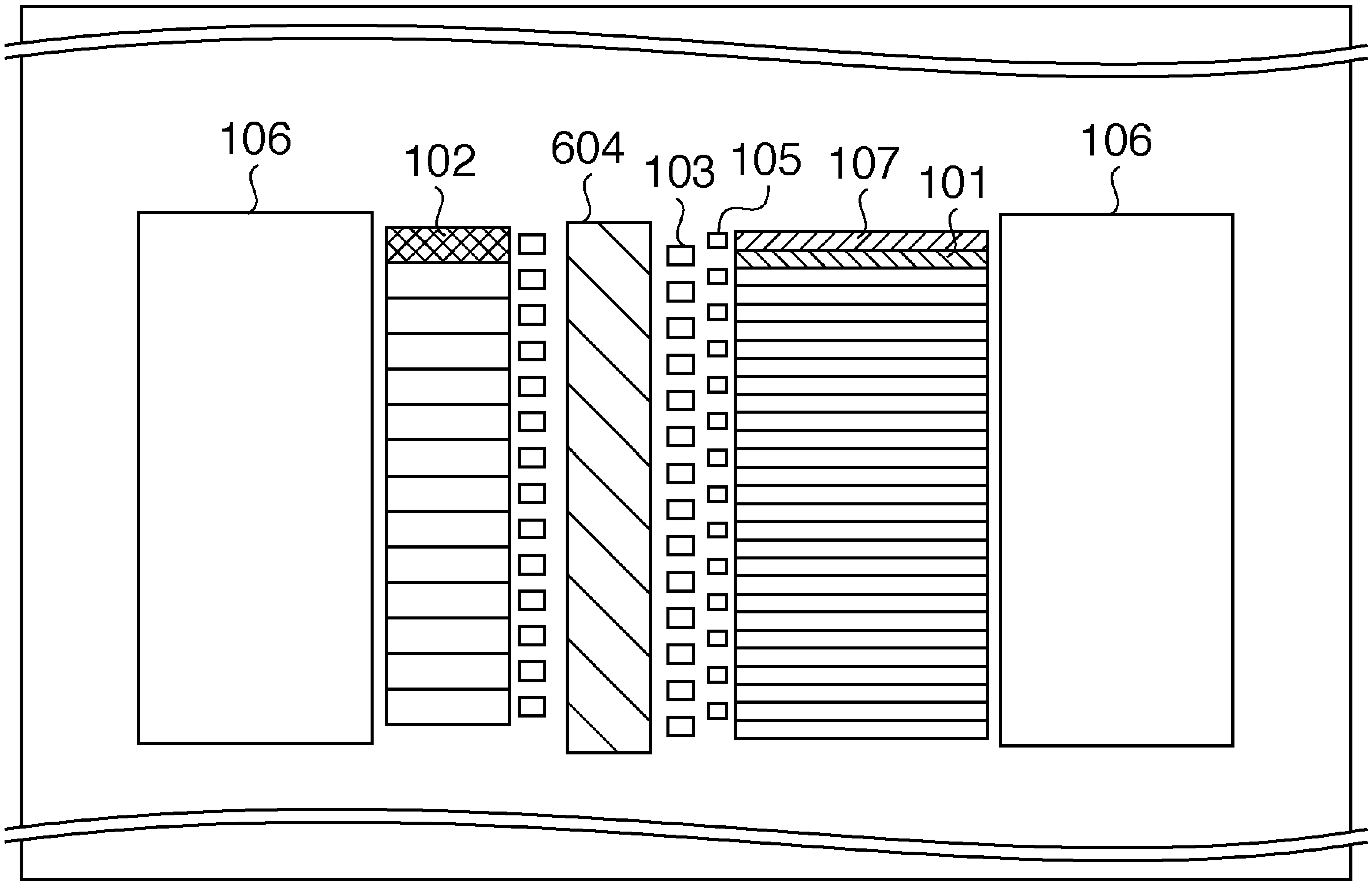


FIG. 13

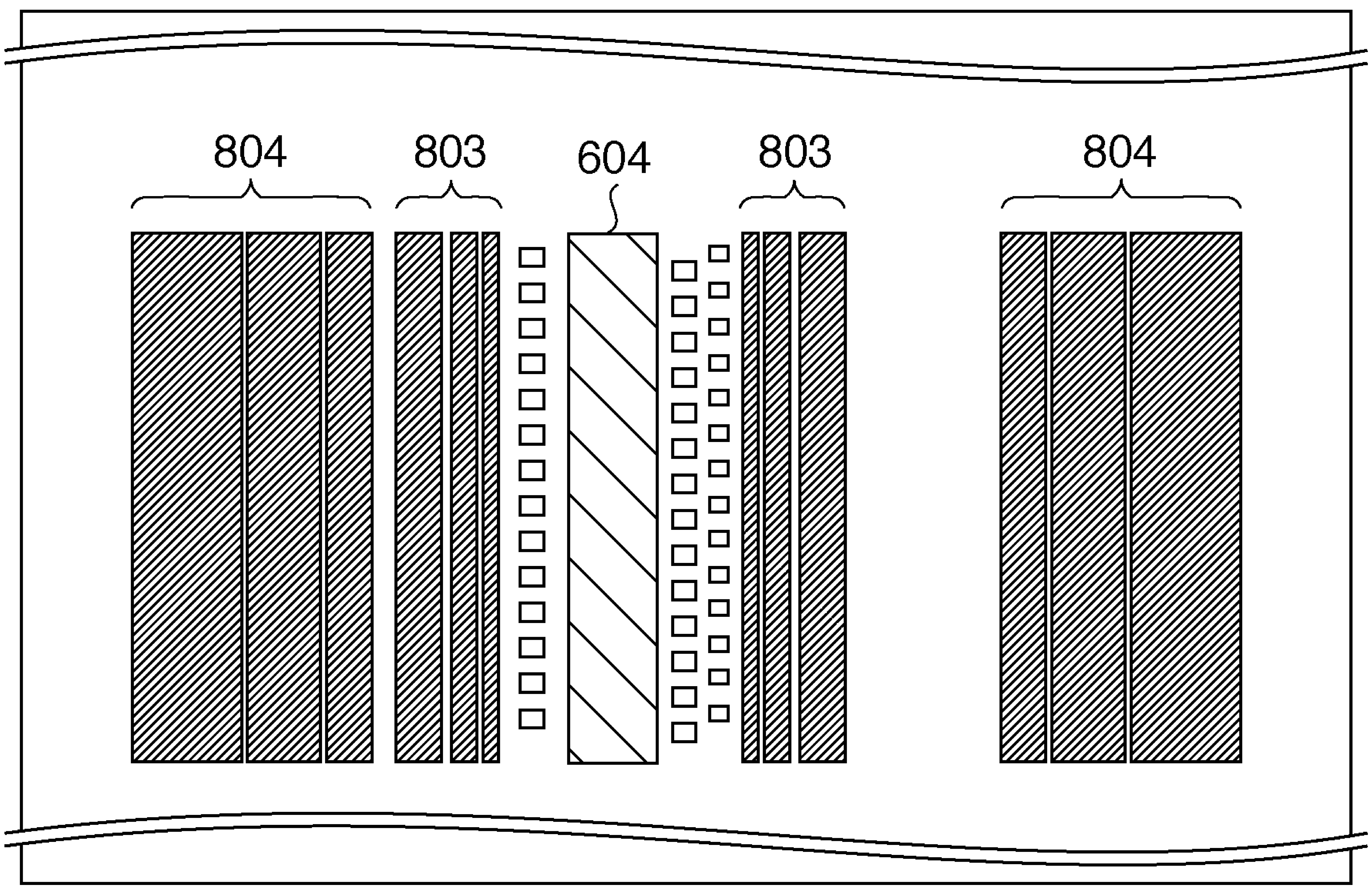


FIG. 14

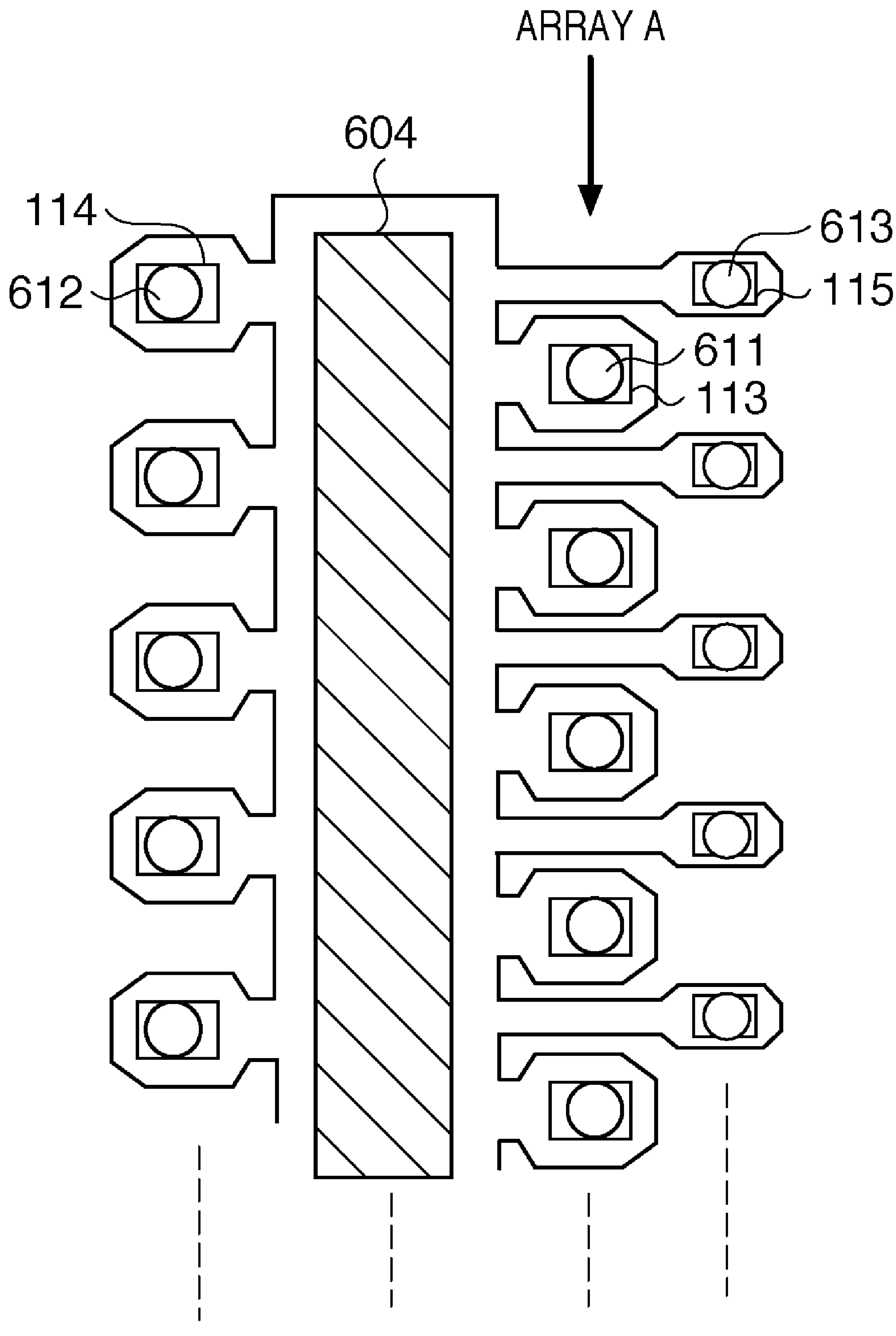


FIG. 15

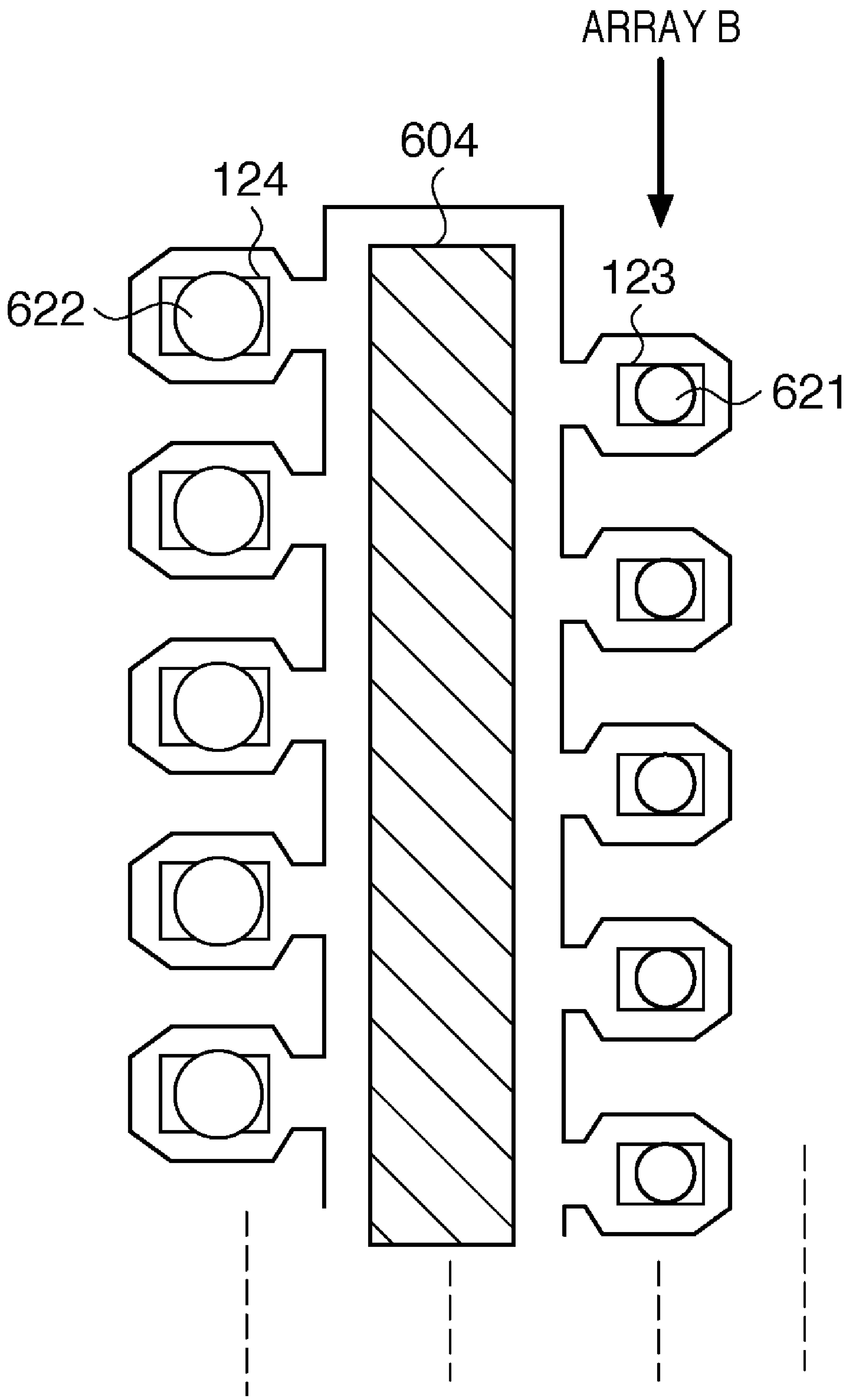


FIG. 16

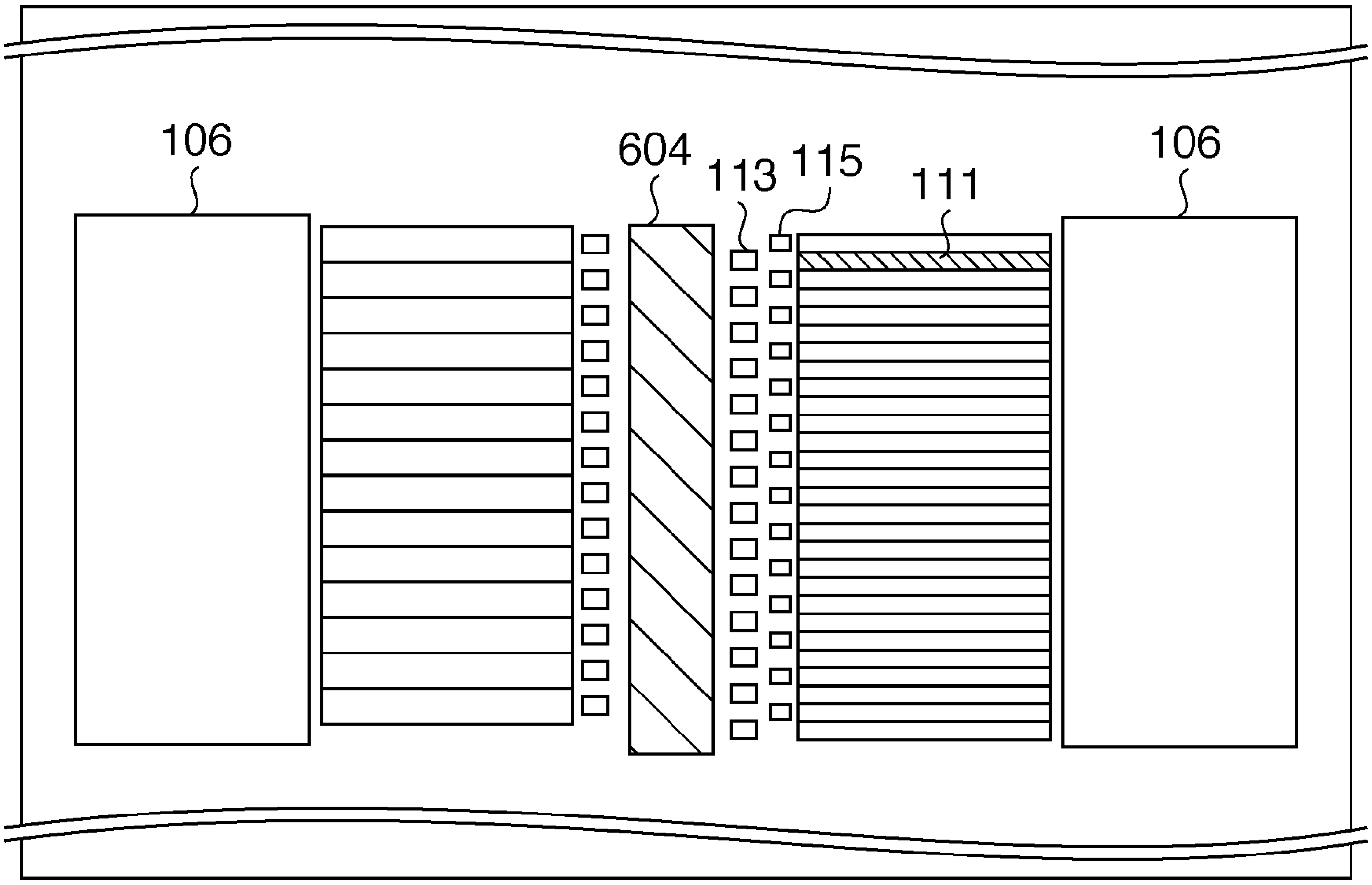


FIG. 17

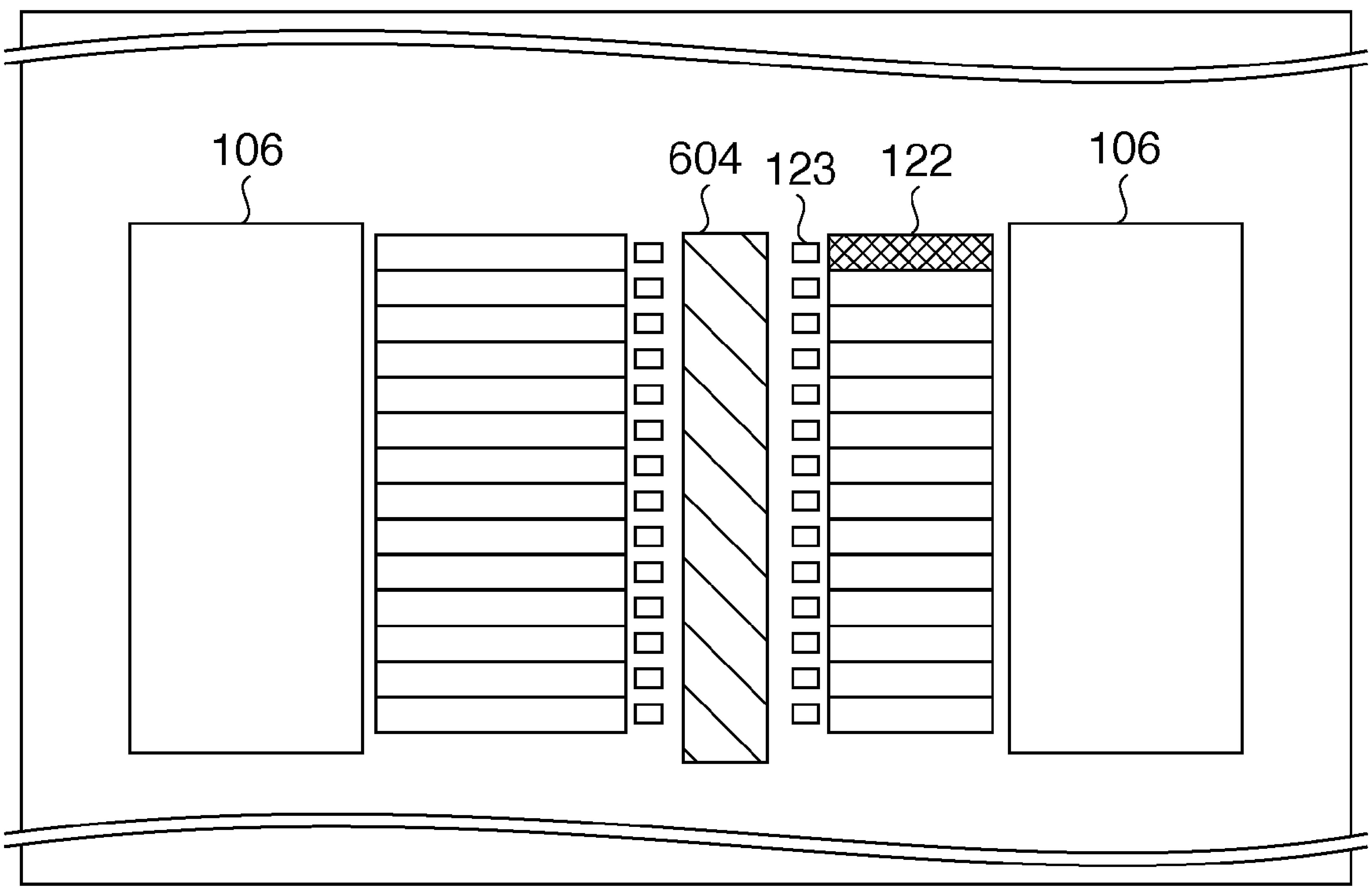


FIG. 18

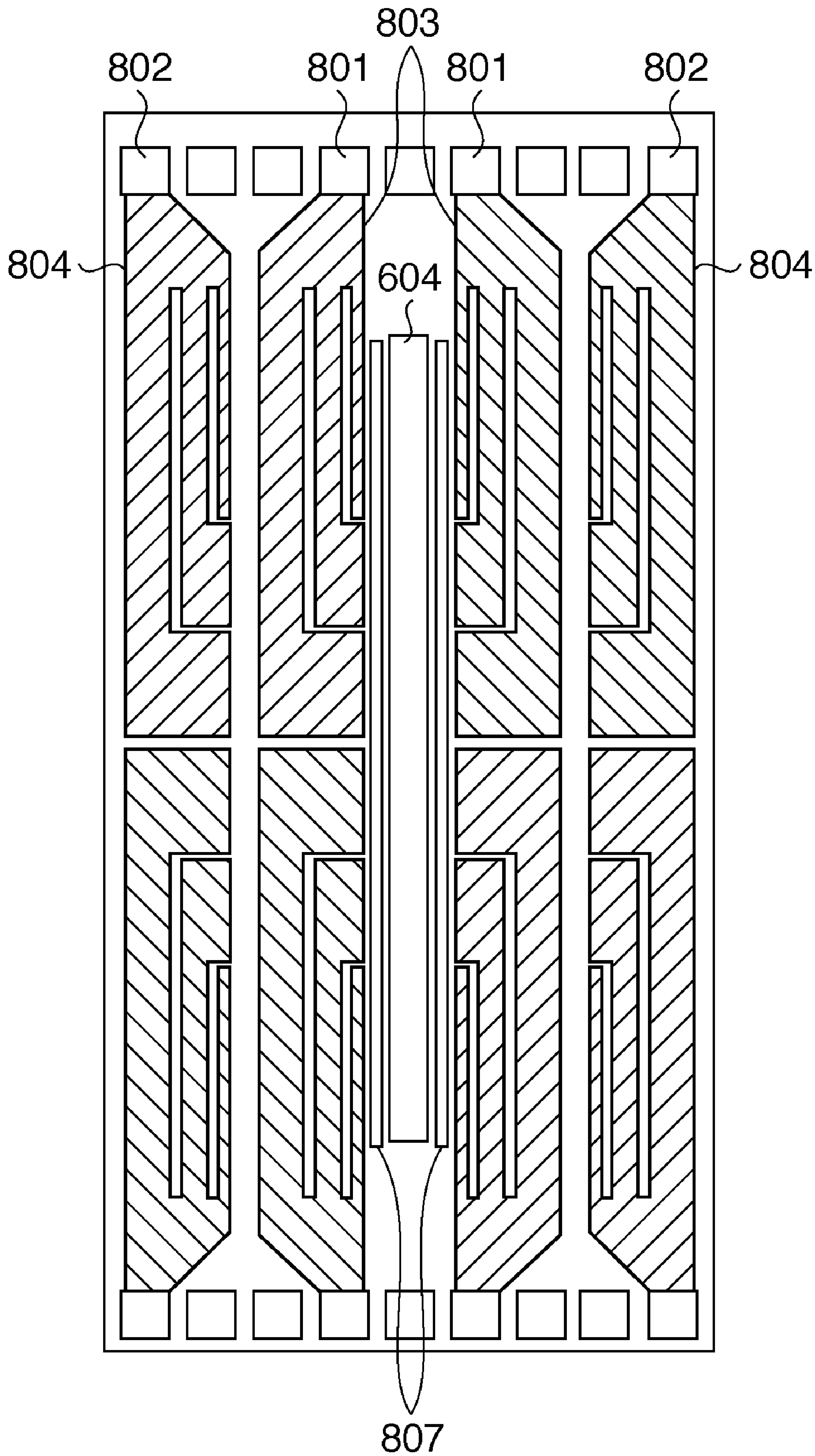
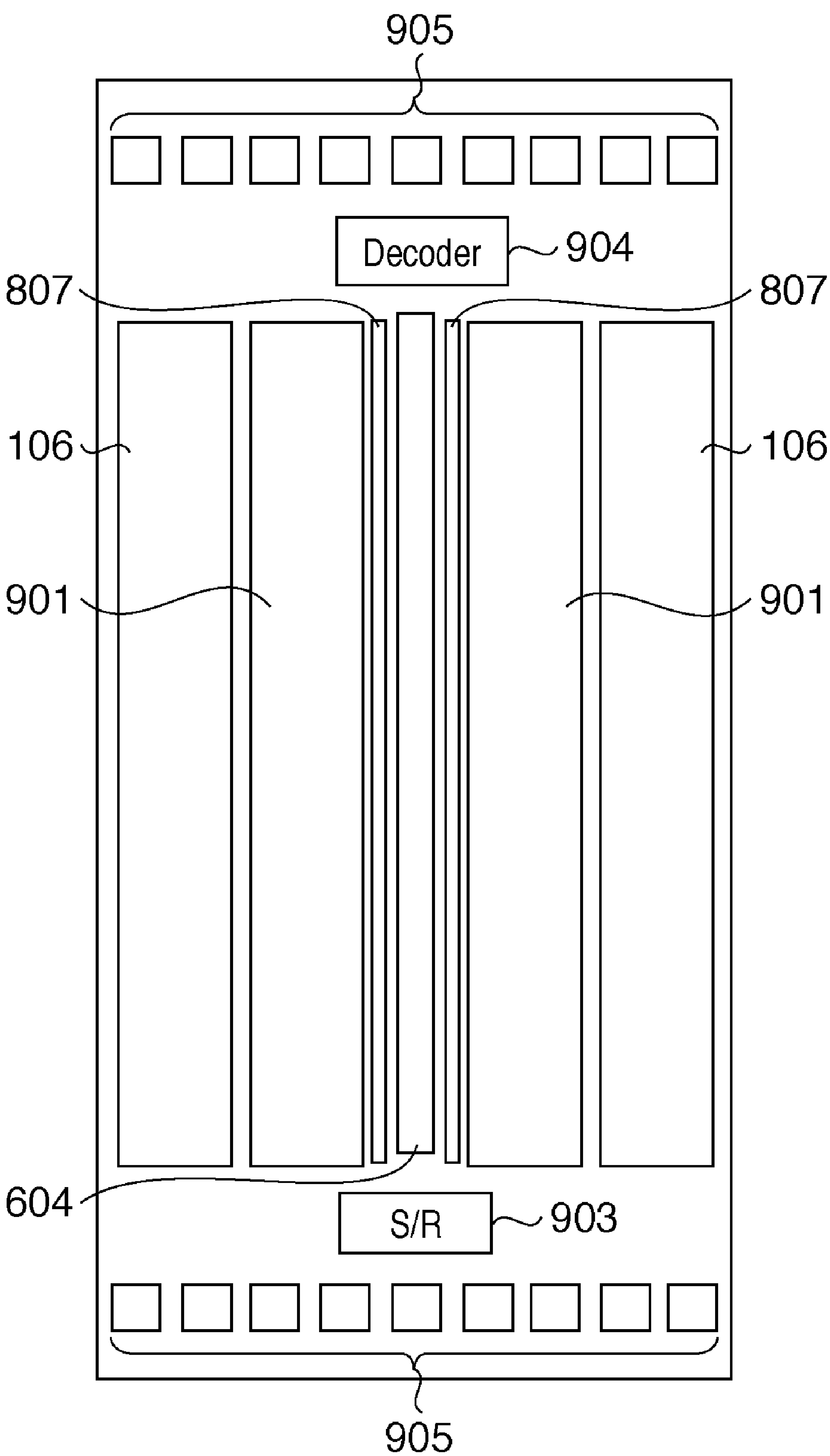


FIG. 19



ELEMENT SUBSTRATE, PRINTHEAD, AND HEAD CARTRIDGE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an element substrate for an inkjet printhead, a printhead using the element substrate, and a head cartridge having the printhead.

2. Description of the Related Art

The electrothermal transducers (heaters) of a printhead mounted in an inkjet printing apparatus, and their driving circuit and wiring pattern are generally formed on a single substrate using a semiconductor process technique. A known example of the printhead having this arrangement is one disclosed in U.S. Pat. No. 7,216,960.

FIGS. **18** and **19** are schematic views showing an example of a conventional element substrate for an inkjet printhead.

FIGS. **18** and **19** characteristically show the same part of the element substrate. FIG. **18** mainly shows a heater driving power supply wiring pattern and ground wiring pattern. FIG. **19** mainly shows a heater driver, logic wiring pattern, and logic circuit below these wiring patterns.

The arrangement of respective components will be explained first with reference to FIG. **19**. An ink supply port **604** is formed at the center of the element substrate, and heater arrays **807** are arranged on the two sides of the ink supply port **604**. Ink channels, and orifices for discharging ink are formed in the element substrate in correspondence with respective heaters, and ink is supplied to them via the ink supply port **604**. A driver array **901** is arranged on the outer side of each heater array **807**. A logic circuit wiring pattern and logic circuit **106** are arranged on the outer side of each driver array **901**. Connection terminals **905** are arranged near each short side of the element substrate. A shift register (S/R) **903**, a decoder **904**, a temperature sensor (not shown), and the like are interposed between the connection terminals **905** and the ink supply port **604**.

In FIG. **18**, a heater driving power supply wiring pattern **803** is arranged above each driver array **901**. A ground wiring pattern **804** is arranged above each logic circuit **106**. These wiring patterns are connected to the outside via heater driving connection terminals **801** and ground connection terminals **802**, respectively.

Heaters in the heater array are driven by a so-called time division driving method of shifting the driving timing for each block of simultaneously drivable heaters.

In order to make the wiring resistances of arrayed heaters almost equal to each other, the power supply wiring pattern is divided for each driving group of heaters not driven simultaneously. The respective wiring patterns have different widths in accordance with the distance from the connection terminal, so as to make resistance values almost equal to each other. For example, a wiring pattern having a longer distance and larger wiring length has a larger width. In each driving group, the number of simultaneously driven heaters is one, so the voltage drop by the wiring resistance is almost equal between heaters.

In FIG. **19**, the connection terminals **905** are arranged near the two short sides of the element substrate. This is because the wiring width becomes excessively large if the connection terminals **905** are arranged on only one short side of the element substrate and the wiring pattern extends up to the other short side. As shown in FIG. **18**, the power supply wiring patterns are symmetrical in the longitudinal direction on the sheet surface of FIG. **18**. That is, the heater driving connection terminals **801** and ground connection terminals **802** are necessary on the two short sides.

Terminals other than the heater driving connection terminal **801** and ground connection terminal **802** are used as a heater driving enable terminal, data input terminal, latch terminal, clock terminal, logic power supply terminal, temperature sensor terminal, rank measurement terminal, and the like.

These days, inkjet printing apparatuses are demanded for higher printing resolutions and higher printing speeds. The element substrate for an inkjet printhead needs to be elongated to cope with a higher-density arrangement of heaters and logic circuits, a larger number of orifice arrays corresponding to a larger number of ink colors, and a larger number of heaters. As a result, the area of the element substrate increases, raising the cost.

FIG. **5** is a plan view of an example of the element substrate of an inkjet printhead. As represented by an orifice portion **501** in FIG. **5**, a plurality of types of orifices having different orifice diameters and the like are arranged so that ink of the same color can be discharged by different discharge amounts. Known examples of the printhead having this arrangement are ones disclosed in U.S. Pat. No. 6,137,502 and Japanese Patent Laid-Open No. 2007-144711 (WO2007/061138).

Referring to FIG. **6** which is an enlarged view of the orifice portion **501**, orifices **602** of array A have a discharge amount of 2 pl and an array density of 600 dpi. Orifices **601** of array B have a discharge amount of 2 pl and an array density of 600 dpi. Orifices **603** of array C have a discharge amount of 1 pl and an array density of 600 dpi. Arrays B and C are positioned on the same side of an ink supply port **604**, and orifices are staggered. The orifices of arrays B and C are arrayed at an array density of 1,200 dpi, which is substantially double that of array A. In other words, orifices are formed at an array density of 600 dpi on one side of the ink supply port **604**, and those are formed at an array density of 1,200 display on the other side.

FIG. **10** is a view schematically showing the element substrate of the orifice portion **501** in FIG. **5**. As shown in FIG. **10**, heaters **104** corresponding to the orifices **602** of array A are arranged on one side of the ink supply port **604**, whereas heaters **103** corresponding to the orifices **601** of array B and heaters **105** corresponding to the orifices **603** of array C are arranged on the other side. A driver **101** corresponds to each heater **103**, a driver **102** corresponds to each heater **104**, and a driver **107** corresponds to each heater **105**. Reference numeral **106** denotes each logic circuit. In the array of the drivers **102**, the drivers are arrayed at an array density of 600 dpi. In the array of the drivers **101** and **107**, the drivers are arrayed at an array density of 1,200 dpi.

Problems will be described, which arise when a plurality of orifice arrays having the same discharge amount exist on a single element substrate, and the drivers of respective driver arrays are formed at different array densities in the respective driver arrays corresponding to the respective orifice arrays. The following description assumes that the driver is a transistor.

FIG. **11** shows the arrangement of the heater driving power supply wiring patterns **803** and ground wiring patterns **804** which are superposed on the circuit shown in FIG. **10** via an insulating film.

The heaters **103** and **104** discharge ink droplets in the same discharge amount of 2 pl. To make discharge characteristics such as the discharge amount and discharge speed equal to each other, driving conditions are desirably made equal. That is, the heaters **103** and **104** are desirably driven with the same pulse using the same heat enable signal which defines the period during which the heater is driven.

The number of heat enable signal terminals is desirably small in order to downsize the element substrate. A small number of heat enable signals is advantageous even in cost because the printing apparatus main body need not have many pulse tables.

To make discharge characteristics such as the discharge amount and discharge speed equal to each other, and share the heat enable signal, it is desirable to make the size equal between heaters and make the ON resistance and wiring resistance equal between drivers. In FIG. **10**, the drivers **101** and **102** have the same width in the driver array direction and the same length L**1** in a direction perpendicular the driver array direction, and have the same size. Thus, the drivers **101** and **102** have the same ON resistance, and the heater driving power supply wiring pattern **803** and ground wiring pattern **804** in FIG. **11** have the same sizes and wiring resistances for both the heaters **103** and **104**. In this case, the heaters **103** and **104** can be driven by the same heat enable signal, and attain the same discharge characteristics.

However, as is apparent from the drivers **102** in FIG. **10**, they are arranged in accordance with a 1,200-dpi heater array though they are originally arrayed at 600 dpi. A gap is generated between adjacent drivers, resulting in poor arrangement efficiency, that is, an unnecessarily large chip size.

FIGS. **12** and **13** are schematic views, similar to FIGS. **10** and **11**, and show an example of improving the driver arrangement efficiency.

The drivers **102** are arrayed at 600 dpi, similar to FIG. **10**. In order to make the ON resistance of the drivers **102** equal to that of the drivers **101** arrayed at 1,200 dpi, the length of the driver **102** in a direction perpendicular to the heater array direction is halved while the area of the driver **102** is kept constant, preventing generation of an unnecessary space.

In this case, as shown in FIG. **13**, each driver needs to be connected on the outer side to the ground wiring pattern **804**. The wiring width of the heater driving power supply wiring pattern **803** is narrowed in accordance with the driver **102**. Although the area above the drivers **101** and **107** is sufficiently large, the wiring width is narrowed to set the wiring resistance of the driver **101** equal to that of the driver **102** and make discharge characteristics equal to each other.

In this case, the driver arrangement efficiency can be increased to downsize the element substrate, but the wiring resistance rises, decreasing the electrical efficiency.

As described above, when a plurality of orifice arrays having the same discharge amount exist on a single element substrate, and transistors which form respective driver arrays are formed at different array densities, it is difficult to achieve both a small-size element substrate and high electrical efficiency.

SUMMARY OF THE INVENTION

The present invention can provide an element substrate capable of achieving both a small-size element substrate and high electrical efficiency when a plurality of orifice arrays having the same discharge amount exist on a single element substrate, and transistors which form respective driver arrays are formed at different array densities.

An element substrate according to the present invention comprises a first printing element array and a second printing element array each formed of a plurality of printing elements for discharging a liquid by substantially the same liquid discharge amount; a third printing element array formed of printing elements which discharge the liquid by a discharge amount different from the discharge amount of the printing elements of the first and second printing element arrays and are staggered from the printing elements of the second printing element array; a first driver array formed of a plurality of driving elements arranged near the first printing element array, a second driver array formed of a plurality of driving elements arranged near the second printing element array, and a third driver array formed of a plurality of driving elements arranged near the third printing element array, the second driver array and the third driver array forming a single array; a first power supply wiring pattern arranged at a position where the first power supply wiring pattern overlaps an area where the first driver array is arranged, and in a different layer; and a second power supply wiring pattern arranged in the layer and at a position where the second power supply wiring pattern overlaps an area where the second driver array and the third driver array are arranged, wherein an array density of the driving elements of the first driver array is lower than an array density of the driving elements of the single array formed from the second driver array and the third driver array, an area of each of the driving elements of the first driver array is larger than an area of each of the driving elements of the second driver array and is larger than an area of each of the driving elements of the third driver array, and a wiring width of the first power supply wiring pattern in a direction perpendicular to the printing element arrays is smaller than a wiring width of the second power supply wiring pattern.

The present invention provides a printhead and head cartridge having the element substrate.

According to the present invention, the area of drivers arrayed at low density is set larger than that of drivers arrayed at high density. The ON resistance of the drivers arrayed at low density becomes lower than that of the drivers arrayed at high density. To make driving conditions equal between the array of orifices corresponding to the drivers arrayed at low density and that of orifices corresponding to the drivers arrayed at high density, the wiring resistance of the drivers arrayed at low density is set higher than that of the drivers arrayed at high density. That is, the heater driving power supply wiring pattern of the drivers arrayed at low density can be narrowed. The element substrate can be efficiently downsized without decreasing the electrical efficiency.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view showing the heater, driver, and logic circuit of an element substrate according to the present invention;

FIG. **2** is a view showing the power supply wiring pattern and the like of the element substrate according to the present invention;

FIG. **3** is a schematic view obtained by superposing FIGS. **1** and **2**;

FIG. **4** is a view showing a state in which the element substrate according to the present invention is mounted on a TAB tape;

FIG. **5** is an enlarged view of the element substrate;

FIG. **6** is an enlarged view of an orifice portion;

FIG. **7** is a view showing an entire printhead;

FIG. **8** is a schematic view of an inkjet printing apparatus;

FIG. **9** is a block diagram showing the control arrangement of the inkjet printing apparatus;

FIG. **10** is a view showing the heater, driver, and logic circuit of a conventional element substrate;

FIG. **11** is a view showing the power supply wiring pattern and the like of the conventional element substrate;

FIG. **12** is a view showing the heater, driver, and logic circuit of a conventional element substrate;

FIG. **13** is a view showing the power supply wiring pattern and the like of the conventional element substrate;

FIG. **14** is an enlarged view of an orifice portion;

FIG. **15** is an enlarged view of an orifice portion;

FIG. **16** is a view showing the heater, driver, and logic circuit of an element substrate according to the present invention;

FIG. **17** is a view showing the heater, driver, and logic circuit of an element substrate according to the present invention;

FIG. **18** is a view showing the power supply wiring pattern and the like of a conventional element substrate; and

FIG. **19** is a view showing the heater, driver, and logic circuit of the conventional element substrate.

DESCRIPTION OF THE EMBODIMENTS

Preferred embodiments of the present invention will be described in detail below with reference to the accompanying drawings. The same reference numerals denote the same parts, and a description thereof will not be repeated.

In this specification, the term "printing" (to be also referred to as "print" hereinafter) not only includes the formation of significant information such as characters and graphics, but also broadly includes the formation of images, figures, patterns, and the like on a print medium, or the processing of the medium, regardless of whether they are significant or insignificant and whether they are so visualized as to be visually perceptible by humans.

Also, the term "print medium" not only includes paper used in general printing apparatuses, but also broadly includes materials capable of accepting ink, such as cloth, a plastic film, a metal plate, glass, ceramics, wood, and leather.

The term "ink" should be extensively interpreted similar to the definition of "print" described above. "Ink" includes a liquid which, when applied onto a print medium, can form images, figures, patterns, and the like, can process the print medium, and can process ink. Ink processing includes solidification or insolubilization of a coloring agent in ink applied to the print medium.

The term "element substrate" in the description means not a simple substrate made of a silicon semiconductor, but a substrate having elements, wiring patterns, and the like.

The expression "on an element substrate" includes not only "on the surface of an element substrate", but also "inside of an element substrate near its surface". The term "built-in" in the present invention means not "simply arrange separate elements on a substrate", but "integrally form and manufacture elements on an element substrate by a semiconductor circuit manufacturing process or the like".

The schematic structure of an inkjet printing apparatus will be explained.

FIG. **8** is a perspective view of the schematic outer appearance of an inkjet printing apparatus to which the present invention is applicable. In FIG. **8**, a carriage HC supports an integral head cartridge incorporating a printhead **1708** and an ink tank IT (liquid container) which contains ink. The carriage HC reciprocates in directions indicated by arrows a and b. During reciprocation, the printhead discharges ink to print.

A control arrangement for executing printing control of the inkjet printing apparatus will be explained with reference to the block diagram of FIG. **9**. In FIG. **9** showing a control circuit, an interface **1700** receives a print signal from a host computer or the like. Reference numeral **1701** denotes an MPU. A ROM **1702** stores control programs to be executed by the MPU **1701**. A DRAM **1703** saves various data (e.g., the print signal, and print data supplied to a printhead **1708**). A gate array (G.A.) **1704** controls supply of print data to the printhead **1708**, and also controls data transfer between the interface **1700**, the MPU **1701**, and the DRAM **1703**. A carrier motor **1710** conveys the printhead. A conveyance motor **1709** conveys a print medium. A motor driver **1706** drives the conveyance motor **1709**. A motor driver **1707** drives the carrier motor **1710**. Reference numeral **1708** denotes the printhead; and **403**, an element substrate for the printhead.

The operation of the control arrangement will be described. When a print signal is input to the interface **1700**, it is converted into print data between the gate array **1704** and the MPU **1701**. Then, the motor drivers **1706** and **1707** are driven, and the printhead **1708** and the element substrate **403** are driven in accordance with print data, executing printing.

The printhead will be described.

FIG. **4** is a view showing a state in which the element substrate **403** having a plurality of heaters is mounted on a TAB tape **401**. Contact terminals **402** are arranged on one end of the TAB tape **401** to connect the TAB tape **401** to the inkjet printing apparatus main body. The element substrate **403** is connected on the other end via inner leads.

FIG. **5** is an enlarged view of a portion **404** in FIG. **4**. Inner leads **503** and **504** project from the device holes of the TAB tape **401**. The inner leads **503** and **504** are electrically connected to connection terminals by gang bonding.

FIG. **7** shows the completed form of the printhead. The TAB tape **401** in FIG. **4** is joined to the ink tank IT. The inner leads projecting from the device holes are sealed with a sealing material **702**. The TAB tape **401** is bent to fix the contact terminals **402** tightly to the wall surface of the ink tank IT. The element substrate serves as the upper side in FIG. **7**, but as the lower side when mounted in the inkjet printing apparatus.

First Embodiment

An element substrate and printhead according to the first embodiment will be described with reference to FIGS. **1** to **3**.

FIG. **1** is a schematic view showing heaters **103**, **104**, and **105**, drivers **101**, **102**, and **107**, and logic circuits **106** of the element substrate according to the first embodiment.

An ink supply port **604** is formed at the center of the element substrate. The array of the heaters **104** and the array of the drivers **102** are arranged close to each other on one side of the ink supply port **604**, whereas the arrays of the heaters **103** and **105** and the arrays of the drivers **101** and **107** are arranged close to each other on the other side. Each driver is a transistor serving as a kind of driving element. In each heater array, **512** heaters are arrayed at an array density (pitch) of 600 dpi. The heaters **103** and **105** are staggered. In the array of the drivers **102** corresponding to the heaters **104**, **512** drivers are arrayed at a pitch of 600 dpi. In the array of the drivers **101** corresponding to the heaters **103** and the drivers **107** corresponding to the heaters **105**, 1,024 drivers are arrayed at a pitch of 1,200 dpi.

The heaters **103** and **104** have the same area and shape in order to discharge ink by the same ink discharge amount (liquid discharge amount).

FIG. **6** shows orifices (printing elements) corresponding to the respective heater arrays shown in FIG. **1**. The heater **103** corresponds to an orifice **601**, and the heater **104** corresponds to an orifice **602**. The discharge amount from each orifice is 2 pl. The heater **105** corresponds to an orifice **603**, and the discharge amount is 1 pl. The array of the orifices **602** serves as the first orifice array (first printing element array), that of the orifices **601** serves as the second orifice array (second printing element array), and that of the orifices **603** serves as the third orifice array (third printing element array). The array of the drivers **102** serves as the first driver array, and that of the drivers **101** and **107** serves as the second driver array.

FIG. **2** is a schematic view showing the power supply wiring patterns and the like of the element substrate according to the first embodiment.

FIG. **3** is a schematic view obtained by superposing the power supply wiring patterns in FIG. **2** on the drivers and logic circuits in FIG. **1**. Heater driving power supply wiring patterns **803***a* and **803***b* are arranged on the array of the drivers **102** and that of the drivers **101** and **107**, respectively. Ground wiring patterns **804** are arranged on the logic circuits **106**. The element substrate according to the present invention has this multilayered structure. The heater driving power supply wiring pattern **803***a* serves as the first power supply wiring pattern, and the heater driving power supply wiring pattern **803***b* serves as the second power supply wiring pattern. The first power supply wiring pattern is arranged at a position where it overlaps an area where the first driver array is arranged, and in a different layer. The second power supply wiring pattern is arranged in this layer and at a position where it overlaps an area where the second and third driver arrays are arranged.

In FIG. **1**, the drivers **101** and **102** drive heaters having the same discharge amount of 2 pl, so their areas should be originally made equal to have the same ON resistance. In the first embodiment, however, letting S**1** be the area of the driver **101** and S**2** be that of the driver **102**, S**2**>S**1**. That is, the area of the driver **102** is set larger than that of the driver **101**. The array density of the first driver array is lower than that of the array of the drivers **101** and **107**. In the first embodiment, the drivers **101** and **107** are arrayed at 1,200 dpi, and the drivers **102** are arrayed at 600 dpi. Thus, sizes L**1** and L**2** of the drivers **101** and **102** in a direction perpendicular to the heater array direction satisfy L**2**>L**1**/2.

As a result, an ON resistance R**102** of the driver **102** becomes lower than an ON resistance R**101** of the driver **101**. To make driving conditions equal to each other, the wiring resistance of the driver **102** needs to be set higher than that of the driver **101**. In FIG. **2**, the heater driving power supply wiring pattern **803***a* above the driver **102** is narrower (in a direction perpendicular to the printing element array) than the heater driving power supply wiring pattern **803***b* above the drivers **101** and **107**. Wiring resistances R**803***a* and R**803***b* corresponding to the respective heater driving power supply wiring patterns satisfy a relation:

$$R102+R803a=R101+R803b$$

Concrete numerical values in the first embodiment are L**1**=200 μm, L**2**=120 μm, R**101**=40Ω, R**102**=33.3Ω, and R**803***b*=10Ω. Since the ON resistances of the drivers **102** and **101** are different by 6.7Ω, R**803***a*=16.7Ω is set to satisfy the above relation.

Assuming that L**1** is almost equal to the wiring width of the heater driving power supply wiring pattern **803***b*, the entire wiring width of the heater driving power supply wiring pattern **803***b* is set to 200 μm. The wiring width of the heater driving power supply wiring pattern **803***a* is calculated from these values, obtaining 200 μm×16.7Ω/10Ω=120 μm, which is almost equal to the width L**2**. The area above the drivers can be efficiently used as a wiring area.

This arrangement of the element substrate makes it possible to drive the heaters **103** and **104** having the same discharge amount under the same driving conditions.

Compared to a prior art shown in FIG. **10**, the drivers **102** arrayed at 600 dpi can be downsized.

Compared to a prior art shown in FIGS. **12** and **13**, the size of a conventional driver **102** is smaller. However, the sum of the wiring resistance and ON resistance can be suppressed smaller than the conventional one, achieving high electrical efficiency.

Second Embodiment

An element substrate and printhead according to the second embodiment will be described with reference to FIGS. **14** to **17**.

FIG. **14** is an enlarged view of an orifice portion **501** in FIG. **5**, that is, orifice arrays for discharging cyan ink. FIG. **15** is an enlarged view of an orifice portion **502** in FIG. **5**, that is, orifice arrays for discharging yellow ink.

The ink droplet discharge amount from each orifice in the second embodiment is different from that in the first embodiment. In FIG. **14**, an orifice **612** discharges a 5-pl ink droplet, an orifice **611** discharges a 2-pl ink droplet, and an orifice **613** discharges a 1-pl ink droplet. A heater **114** corresponds to the orifice **612**, a heater **113** corresponds to the orifice **611**, and a heater **115** corresponds to the orifice **613**. In FIG. **15**, an orifice **622** discharges a 5-pl ink droplet, and an orifice **621** discharges a 2-pl ink droplet. A heater **124** corresponds to the orifice **622**, and a heater **123** corresponds to the orifice **621**.

Array A shown in FIG. **14** and array B shown in FIG. **15** discharge inks by the same volume though the ink color is different. It is desirable to make driving conditions equal to each other, similar to the first embodiment.

FIG. **16** is a view showing drivers and logic circuits corresponding to FIG. **14**. FIG. **17** is a view showing drivers and logic circuits corresponding to FIG. **15**.

The heaters **113** and **123** for discharging ink droplets of the same 2-pl discharge amount are equal in size to the heaters **103** and **104** used in the first embodiment. A driver **111** corresponding to the heater **113** is equal in size to the driver **101** corresponding to the heater **103** used in the first embodiment. A driver **122** corresponding to the heater **123** is equal in size to the driver **102** corresponding to the heater **104** used in the first embodiment. Although not shown, the power supply wiring pattern of each heater in the second embodiment is also equal in size to that of a corresponding heater in the first embodiment. This arrangement allows driving the heaters **113** and **123** having the same discharge amount under the same driving conditions.

The array of the orifices **621** serves as the first orifice array, that of the orifices **611** serves as the second orifice array, and that of the orifice **613** serves as the third orifice array. The array of the driver **122** serves as the first driver array, and that of the drivers **111** and drivers corresponding to the heaters **115** serves as the second driver array.

Similar to the first embodiment, the second embodiment can also increase the electrical efficiency by suppressing the sum of the wiring resistance and ON resistance small while downsizing the driver. In the first and the second embodiment, the first power supply wiring pattern and the second power supply wiring pattern may be arranged in the same layer.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2007-276756, filed Oct. 24, 2007, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An element substrate comprising:

a first printing element array and a second printing element array each formed of a plurality of printing elements for discharging a liquid by substantially the same liquid discharge amount;

a third printing element array formed of printing elements which discharge the liquid by a discharge amount different from the discharge amount of the printing elements of the first and second printing element arrays and are staggered from the printing elements of the second printing element array;

a first driver array formed of a plurality of driving elements arranged near the first printing element array, a second driver array formed of a plurality of driving elements arranged near the second printing element array, and a third driver array formed of a plurality of driving elements arranged near the third printing element array, the second driver array and the third driver array forming a single array;

a first power supply wiring pattern arranged at a position where the first power supply wiring pattern overlaps an area where the first driver array is arranged, and in a different layer; and

a second power supply wiring pattern arranged in the layer and at a position where the second power supply wiring pattern overlaps an area where the second driver array and the third driver array are arranged,

wherein an array density of the driving elements of the first driver array is lower than an array density of the driving elements of the single array formed from the second driver array and the third driver array,

an area of each of the driving elements of the first driver array is larger than an area of each of the driving elements of the second driver array and is larger than an area of each of the driving elements of the third driver array, and

a wiring width of the first power supply wiring pattern in a direction perpendicular to the printing element arrays is smaller than a wiring width of the second power supply wiring pattern.

2. The substrate according to claim **1**, wherein an array density of the printing elements of the first printing element array is lower than an array density of the printing elements of the second printing element array and the third printing element array.

3. The substrate according to claim **1**, wherein an ON resistance of the driving elements of the first driver array is lower than an ON resistance of the driving elements of the second driver array.

4. The substrate according to claim **1**, wherein a sum of an ON resistance of the driving elements of the first driver array and a wiring resistance of the first power supply wiring pattern, and a sum of an ON resistance of the driving elements of the second driver array and a wiring resistance of the second power supply wiring pattern are substantially equal to each other.

5. The substrate according to claim **1**, wherein the plurality of printing elements of the first printing element array and the second printing element array comprise heaters having the same shape.

6. An inkjet printhead comprising an element substrate defined in claim **1** in which the plurality of printing elements of the first printing element array and the second printing element array comprise heaters for discharging ink.

7. A head cartridge comprising an element substrate defined in claim **1** and a liquid container which contains ink.

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